

## CLAIMS

### **What is claimed is:**

- 1 1. An apparatus comprising:
- 2 a printed circuit board (PCB) having a top surface and a bottom surface;
- 3 a bottom heat dissipating device attached to the bottom surface of the PCB, a
- 4 top surface of the bottom heat dissipating device thermally coupled with a backside
- 5 surface of one or more electronic components mounted on the bottom surface of the
- 6 PCB;
- 7 a top heat dissipating device attached to the top surface of the PCB; and
- 8 a thermally conductive coupling member thermally coupled with the bottom and
- 9 top heat dissipating devices.
- 1 2. The apparatus of claim 1, wherein the apparatus is a mezzanine card.
- 1 3. The apparatus of claim 2, wherein the top and bottom heat dissipating devices
- 2 are heat spreaders having a length between 100 and 140 millimeters.
- 1 4. The apparatus of claim 3, wherein a height from a bottom surface of the bottom
- 2 heat spreader to a top surface of the top heat spreader is 8.2 millimeters or less.
- 1 5. The apparatus of claim 2, wherein the mezzanine card is in accordance with an
- 2 IEEE 1386 standard.
- 1 6. The apparatus of claim 3, wherein the one or more electronic components
- 2 mounted on the bottom surface of the PCB comprise a processor.

1 7. The apparatus of claim 6, wherein the thermally conductive coupling member  
2 extends along an edge portion of the PCB, and the processor is mounted within 3  
3 millimeters from said edge portion.

1 8. The apparatus of claim 1, wherein the thermally conductive coupling member  
2 comprises a top portion and a bottom portion, wherein the top portion is integral with  
3 the top heat dissipating device and/or the bottom portion is integral with the bottom  
4 heat dissipating device.

1 9. The apparatus of claim 1, further comprising at least one other thermally  
2 conductive coupling member thermally coupled with the bottom and top heat  
3 dissipating devices.

1 10. The apparatus of claim 1, wherein the bottom heat dissipating device and/or the  
2 top heat dissipating device are made substantially of copper or a copper alloy.

1 11. The apparatus of claim 1, wherein a bottom surface of the top heat dissipating  
2 device is thermally coupled with one or more electronic devices mounted on the top  
3 surface of the PCB.

1 12. The apparatus of claim 1, wherein the top and bottom heat dissipating devices  
2 are attached to the PCB with thermally conductive mounting hardware, said mounting  
3 hardware thermally coupled with the top and bottom heat dissipating devices.

1 13. The apparatus of claim 12, wherein the thermally conductive mounting  
2 hardware comprises one or more screws.

1 14. The apparatus of claim 1, wherein the bottom heat dissipating device and/or the  
2 top heat dissipating device have recessed areas of different depths to thermally couple  
3 with electronic components of different heights.

1 15. The apparatus of claim 1, wherein the thermally conductive coupling member  
2 extends along an edge of the PCB by at least one opening formed adjacent a side edge  
3 of the thermally conductive coupling member between the top and bottom heat  
4 dissipating devices.

1 16. The apparatus of claim 15, wherein lengths of the top and bottom heat  
2 dissipating devices extending along the edge of the PCB are between 100 and 140  
3 millimeters and a length of the thermally conductive coupling member extending along  
4 the edge is between 25 and 50 millimeters.

1 17. The apparatus of claim 15, wherein one or more dimensions of the thermally  
2 conductive coupling member are optimized for cooling the PCB by conduction and  
3 convection.

1 18. The apparatus of claim 1, wherein the thermally conductive coupling member  
2 extends along an edge of the PCB with at least one opening formed within the  
3 thermally conductive coupling member.

1 19. A system comprising:  
2 a carrier board having a bus; and  
3 a mezzanine card mounted on the carrier board coupled with the bus, the  
4 mezzanine card comprising a printed circuit board (PCB), a bottom heat dissipating

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5 device attached to a bottom surface of the PCB facing the carrier board, a top surface of  
6 the bottom heat dissipating device thermally coupled with a backside surface of one or  
7 more electronic components mounted on the bottom surface of the PCB, a top heat  
8 dissipating device attached to a top surface of the PCB, and a thermally conductive  
coupling member thermally coupled with the bottom and top heat dissipating devices.

1 20. The system of claim 19, wherein the top and bottom heat dissipating devices are  
2 heat spreaders having a length between 100 and 140 millimeters.

1 21. The system of claim 19, wherein a height from a top surface of the carrier board  
2 to a top surface of the top heat dissipating device is 13.5 millimeters or less.

1 22. The system of claim 21, wherein the mezzanine card is in accordance with an  
2 IEEE 1386 standard.

1 23. The system of claim 19, wherein the bottom heat dissipating device and/or the  
2 top heat dissipating device have recessed areas of different depths to thermally couple  
with electronic components of different heights.

1 24. The system of claim 19, wherein the top and bottom heat dissipating devices are  
2 attached to the PCB with thermally conductive mounting hardware also used to mount  
3 the mezzanine card to the carrier board, said mounting hardware thermally coupled  
4 with the top and bottom heat dissipating devices.

1 25. The system of claim 19, wherein the thermally conductive coupling member  
2 extends along an edge of the PCB with at least one opening formed adjacent the

3 thermally conductive coupling member between the top and bottom heat dissipating  
4 devices.

26. The system of claim 25, wherein lengths of the top and bottom heat dissipating  
2 devices extending along the edge of the PCB are between 100 and 140 millimeters and  
3 a length of the thermally conductive coupling member extending along the edge is  
4 between 25 and 50 millimeters.

27. A method to remove heat from a printed circuit board (PCB) comprising:  
2 attaching a bottom heat dissipating device to a bottom surface of the PCB, a top  
3 surface of the bottom heat dissipating device thermally coupled with a backside surface  
4 of one or more electronic devices mounted on the bottom surface of the PCB;  
5 attaching a top heat dissipating device to a top surface of the PCB; and  
6 thermally coupling the top heat dissipating device with the bottom heat  
7 dissipating device through a thermally conductive coupling member.

28. The method of claim 27, wherein thermally coupling the top heat dissipating  
2 device with the bottom heat dissipating device with the thermally conductive coupling  
3 member comprises forming an opening adjacent to at least one side edge of the  
4 thermally conductive coupling member to allow air flow between the top and bottom  
5 heat dissipating devices.

29. The method of claim 27, wherein the PCB is a PCB of a mezzanine card.

30. The method of claim 29, comprising optimizing one or more dimensions of the  
2 thermally conductive coupling member for cooling the mezzanine card by conduction  
3 and convection.